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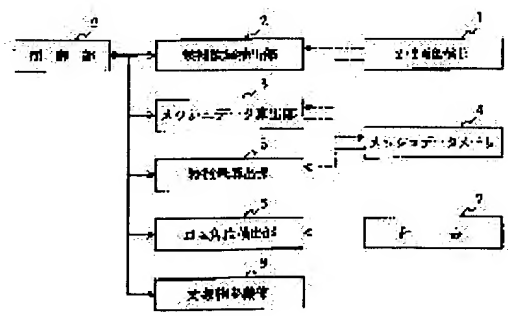
(54) METHOD FOR DETECTING ANGLE OF ROTATION AND RECOGNIZING IMAGE

(57)Abstract:

PURPOSE: To improve the recognition rate of an object by detecting the angle of rotation of the object and rotating the object at the detected angle.

CONSTITUTION: A candidate area extraction part 2 extracts a candidate area of the object from a binary image signal 1 and a mesh data calculation part 3 divides the binary image in the candidate area into meshes (small area), counts black pixels in the respective meshes, and holds the values in a mesh data memory 4. A feature quantity calcuation part 5 generates feature quantity data by arraying mesh data on each circumference of plural concentric circles along the concentric circles from the center of the candidate area. A rotation angle detection part 6 detects the angle of rotation by matching the data with feature quantities with the same radii in a dictionary 7 and performs this detecting process for prescribed circumferences to detect angles of rotation. An object recognition part 8 recognizes the image on the basis of the degree of conviction of the angles of rotation.



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CLAIMS

[Claim(s)]
[Claim 1] In the angle-of-rotation detection approach of extracting a predetermined object out of an input picture signal, and detecting angle of rotation of the this extracted object Extract the candidate field of an object from the inputted this binary picture signal, and the binary image in this candidate field is divided into two or more mesh. The number of black pixels in each divided this mesh (henceforth mesh data) is computed. The characteristic quantity which arranged the mesh data which are on two or more concentric circles from the core of said candidate field in 1-round part sequence from the radix point about each periphery is computed. The characteristic quantity of the periphery of a predetermined radius, The angle-of-rotation detection approach characterized by detecting angle of rotation of said object by collating the characteristic quantity arranged in 1-round part sequence from the radix point, and the characteristic quantity arranged in 1-round part sequence from the location which shifted only the predetermined location from this radix point about the periphery of the same radius as this predetermined radius in a dictionary.
[Claim 2] The angle-of-rotation detection approach according to claim 1 characterized by extracting the candidate field of an object after making this color picture binary, when said input picture signal is a color picture signal.
[Claim 3] The core of said candidate field is the angle-of-rotation detection approach according to claim 1 characterized by being the center of gravity of the black pixel in a candidate field.
[Claim 4] The angle-of-rotation detection approach according to claim 1 characterized by adding the mesh data around attention mesh data when computing said characteristic quantity.
[Claim 5] The angle-of-rotation detection approach according to claim 1 characterized by asking for the class of the maximum frequency based on the histogram of angle of rotation detected from each periphery, and detecting angle of rotation from the average of this class circumference when detecting said angle of rotation.
[Claim 6] The angle-of-rotation detection approach according to claim 1 characterized by not using characteristic quantity of the periphery with which predetermined resolution is not filled when detecting said angle of rotation.
[Claim 7] The angle-of-rotation detection approach according to claim 1 characterized by not using characteristic quantity of this periphery when the distance of the characteristic quantity of the periphery of a predetermined radius and the characteristic quantity of the periphery of the same radius in a dictionary is calculated and this distance exceeds a predetermined threshold at the time of said collating.
[Claim 8] The image recognition approach characterized by recognizing a specific image based on the reliability of angle of rotation according to claim 1 in the image recognition approach of recognizing a specific image, from an input color picture signal.
[Claim 9] The image recognition approach according to claim 8 characterized by recognizing a specific image by rotating an image with angle of rotation detected by the approach according to claim 1, and collating with a dictionary.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the angle-of-rotation detection approach and the image recognition approach of detecting and recognizing angle of rotation of a specific image out of a color picture and monochrome image.
[0002]
[Description of the Prior Art] In the conventional character reader, it is constituted so that it can recognize, even when the alphabetic character graphic form is rotating at the time of an image input. For example, if it cannot recognize and recognize by extracting the description from the inputted alphabetic character graphic form with the alphabetic character image-measuring equipment indicated by JP,61-224088,A, and collating the extracted description with a dictionary, the extracted description is rotated 90 degrees and it recognizes using the same dictionary again.
[0003]
[Problem(s) to be Solved by the Invention] However, the above-mentioned conventional recognition equipment has the fault that the object which is rotating 45 degrees cannot be recognized from performing rotation 90 degrees, for example, without detecting angle of rotation of an object of what can shorten the time amount which recognition takes, since an input image is not rotated.
[0004] The purpose of this invention is by detecting angle of rotation of an object and rotating an object at a detection include angle to offer the angle-of-rotation detection approach and the image recognition approach which raised the recognition rate of an object.
[0005]
[Means for Solving the Problem] In order to attain said purpose, in invention according to claim 1 In the angle-of-rotation detection approach of extracting a predetermined object out of an input picture signal, and detecting angle of rotation of the this extracted object Extract the candidate field of an object from the inputted this binary picture signal, and the binary image in this candidate field is divided into two or more mesh. The number of black pixels in each divided this mesh (henceforth mesh data) is computed. The characteristic quantity which arranged the mesh data which are on two or more concentric circles from the core of said candidate field in 1-round part sequence from the radix point about each periphery is computed. The characteristic quantity of the periphery of a predetermined radius, It is characterized by detecting angle of rotation of said object by collating the characteristic quantity arranged in 1-round part sequence from the radix point, and the characteristic quantity arranged in 1-round part sequence from the location which shifted only the predetermined location from this radix point about the periphery of the same radius as this predetermined radius in a dictionary.
[0006] In invention according to claim 2, when said input picture signal is a color picture signal, after making this color picture binary, it is characterized by extracting the candidate field of an object.
[0007] In invention according to claim 3, the core of said candidate field is characterized by being the center of gravity of the black pixel in a candidate field.
[0008] In invention according to claim 4, when computing said characteristic quantity, it is characterized

by adding the mesh data around attention mesh data.
[0009] In invention according to claim 5, when detecting said angle of rotation, it asks for the class of the maximum frequency based on the histogram of angle of rotation detected from each periphery, and is characterized by detecting angle of rotation from the average of this class circumference.
[0010] In invention according to claim 6, when detecting said angle of rotation, it is characterized by not using characteristic quantity of the periphery with which predetermined resolution is not filled.
[0011] In invention according to claim 7, when the distance of the characteristic quantity of the periphery of a predetermined radius and the characteristic quantity of the periphery of the same radius in a dictionary is calculated and this distance exceeds a predetermined threshold at the time of said collating, it is characterized by not using characteristic quantity of this periphery.
[0012] In invention according to claim 8, it is characterized by recognizing a specific image based on the reliability of angle of rotation according to claim 1 in the image recognition approach of recognizing a specific image, from an input color picture signal.
[0013] In invention according to claim 9, an image is rotated with angle of rotation detected by the approach according to claim 1, and it is characterized by recognizing a specific image by collating with a dictionary.
[0014]
[Function] The candidate field of an object is extracted from a binary picture signal, and the binary image in the extracted candidate field is divided into a mesh (for example, small field of 2x2-pixel size). The number of black pixels in each mesh is counted, and counted value is held as mesh data. And it matches with the characteristic quantity data of the same radius in the dictionary which created the characteristic quantity data which arranged the mesh data on each periphery in order along with two or more concentric circles from the core of a candidate field, and was drawn up similarly, and angle of rotation is detected. Shifting the matching starting position of the characteristic quantity data of a dictionary, this matching finds the distance of the characteristic quantity data of a dictionary and candidate field data in each matching starting position (that is, total of the distance of each dimension), and detects angle of rotation based on the matching starting position where that distance is the smallest. A predetermined periphery is followed in such detection processing, the histogram of angle of rotation is created, and angle of rotation is detected from the maximum frequency.
[0015]
[Example] Hereafter, one example of this invention is concretely explained using a drawing. Drawing 1 shows the configuration of the example of this invention. In drawing, the candidate field extract section in which 1 extracts a binary picture signal and 2 extracts an object field (rectangle) from the binary picture signal 1, and 3 The mesh-data calculation section which computes the number of black pixels in each mesh by dividing the binary image in a candidate field into a mesh, and 4 The mesh-data memory holding the computed mesh data and 5 The characteristic quantity calculation section which arranges mesh data in 1-round part sequence for every predetermined periphery of a concentric circle from mesh-data memory, and creates characteristic quantity, and 7 The object recognition section the angle-of-rotation detecting element which it is created similarly, and the dictionary which registered characteristic quantity, and 6 perform matching (collating) with the characteristic quantity of an object and a dictionary, and detects angle of rotation, and 8 recognize an image to be based on the reliability of angle of rotation, and 9 are control sections which control the whole. In addition, angle of rotation in this example means the inclination of an object to a main scanning direction.
[0016] <Example 1> As the candidate field extract approach used by this invention, these people should just use the approach (Japanese Patent Application No. No. 341889 [three to], this 4- 267313, this 4-160866) of extracting the circumscription rectangle of the black connected component proposed previously, for example.
[0017] first, a ****** [that it is in the height of the extracted field, the height of the object with which width of face was given beforehand, and the range of width of face] -- judging -- either -- the -- if out of range, it will judge with it not being an object and next processing will not be performed.
[0018] Next, the mesh-data calculation section 3 performs mesh division with the predetermined number

of pixels to the image in a candidate field. Drawing 2 shows the example at the time of dividing the image in a candidate field into a 2x2-pixel mesh (small field). And the number of black pixels in each mesh is counted, and it stores in the mesh-data memory 4 by making the value into mesh data. Drawing 3 shows the example of mesh-data memory about the image of drawing 2 . The mesh whose value is "4" in each mesh expresses that the number of black pixels is four pieces.
[0019] Subsequently, the characteristic quantity calculation section 5 creates characteristic quantity data with reference to the mesh-data memory 4. That is, two or more concentric circles are drawn from a candidate field core, and characteristic quantity data are created by arranging the mesh data on each periphery in round part sequence. This is performed to a predetermined periphery. Drawing 4 shows characteristic quantity data of the mesh on the periphery of a radius 5. In the case of drawing 4 , 28-dimensional data are created as characteristic quantity data of a radius 5.
[0020] Then, the angle-of-rotation detecting element 6 performs matching with the characteristic quantity data in the dictionary 7 drawn up similarly, and the characteristic quantity data of a candidate field about the periphery of this radius. while this matching shifts the matching starting position of the characteristic quantity data of a dictionary 7, total of the distance of each dimension of characteristic quantity data is taken, and distance is the smallest -- it shifts and angle of rotation is detected based on a location.
[0021] Drawing 5 shows the example of distance count of the characteristic quantity of the candidate field of a radius 5, and the characteristic quantity of a dictionary. That is, it shifts, it sets in a location 0 (radix point), and is the sum (in this case) of distance about each dimension of the characteristic quantity data of a dictionary, and the characteristic quantity data of a candidate field. Find a 27-dimensional comrade's distance, and similarly, shift and it sets in a location 1. a zero-order former comrade, a 1-dimensional comrade, and ... It is the sum (in this case) of distance about each dimension of the characteristic quantity data of a dictionary, and the characteristic quantity data of a candidate field. the distance of the dictionary characteristic quantity of 1-dimensional one, and the candidate characteristic quantity of zero-order origin, and ... the distance of the dictionary characteristic quantity of zero-order origin and the candidate characteristic quantity of 27 yuan is found, and hereafter, it shifts and asks for the sum of distance with the dictionary in a location 27. And distance serves as min, it shifts and angle of rotation is detected from a location. For example, in drawing 4 , when it shifts and the location 0 was made into 0 times, distance min shifts and a location 7 is detected, angle of rotation of a candidate field turns into 90 degrees.
[0022] Detection processing of the above-mentioned angle of rotation is performed to a predetermined periphery, the class division of the detection include angle is carried out every 20 degrees, the histogram of angle of rotation is created, and angle of rotation of an object is detected from the average of angle of rotation in the class of the maximum frequency. Drawing 6 shows the example of the histogram of angle of rotation detected from each periphery.
[0023] <Example 2> Drawing 7 shows other configurations of the example of this invention. Different points from an example 1 are the point that the binary image generation section 11 which generates a binary image from a color picture signal (R, G, B) 10 was formed, and a point that the memory 12 which stores a binary image was formed. In this example, an input image is made into a color picture signal (R, G, B), and after creating a binary image with which an object is extracted (a binary image is created by [of a color picture signal] searching for lightness and comparing the lightness with a predetermined threshold), the same processing as an example 1 is performed.
[0024] <Example 3> In this example, characteristic quantity is computed by considering as the center of gravity of the black pixel in a candidate field rather than setting the core of a circle as the core of a candidate field. As mentioned above, the approach of extracting the circumscription rectangle of a black connected component is used as the extract approach of a candidate field. However, by this approach, if a noise is attached to an object, an exact candidate field will not be extracted, but even if it creates the characteristic quantity on a concentric circle with the core of that candidate field, the core of a dictionary and a location gap will arise. In this example, in order to avoid this, the core of a circle was set as the center of gravity of the black pixel in a candidate field, and aggravation of detection precision is

prevented.

[0025] <Example 4> In this example, in case you acquire the mesh data on a periphery, let the mesh data which added an attention mesh and the mesh data of the circumference of it be characteristic quantity data. This prevents precision aggravation of a detection include angle when the center position of a circle has shifted by the noise etc. Drawing 8 shows the example of calculation of the characteristic quantity data which added the mesh data of 3xperimeter 3 size of an attention mesh. For example, since the value of an attention mesh is 2 and the value which is eight meshes of the circumference of it is 10 (2x5), the data of zero-order origin (0 times) are set to 12.

[0026] <Example 5> In the above-mentioned example 1, in case the histogram of angle of rotation is created and it asks for the class of the maximum frequency, when actual angle of rotation is near a class boundary, frequency may be divided into the class whose number is two. So, in this example, for example, it has suitable width of face (class circumference), it asks for the class of the maximum frequency using the weighting moving average etc., and angle of rotation is detected from the average included in all the classes of the width of face.

[0027] <Example 6> In an example 1, the detection include angle of the periphery with which predetermined resolution is not filled may worsen the precision of the whole detection include angle. Here, resolution is the value which divided 360 degrees by the number of mesh for periphery 1 round, and predetermined resolution is the class of a histogram. Therefore, angle of rotation is not detected from the characteristic quantity of the periphery with which predetermined resolution is not filled. For example, a class exceeds 20 degrees, that is, the periphery with which the number of mesh does not fill 18 is not made into the object of include-angle detection.

[0028] <Example 7> Although the include angle when the distance of the characteristic quantity obtained from the periphery of arbitration and the characteristic quantity of a dictionary is the smallest (minimum distance) is made into the detection include angle of the periphery in the above-mentioned example 1, when the minimum distance at that time is comparatively large, possibility that it is not an object is high. So, in this example, a suitable threshold is established and the rotation detection include angle obtained from the periphery of the minimum distance which exceeds this threshold is made into an invalid.

[0029] <Example 8> This example starts the approach of recognizing an image, using the angle-of-rotation detection approach explained in the above-mentioned example. The object recognition section 8 computes the reliability of angle of rotation from the maximum frequency of for example, an angle-of-rotation histogram, and the reliability is used for it as an evaluation value of image recognition. That is, when the same angle of rotation is obtained about every periphery, it is recognized as the image of the inputted object being the same as that of a dictionary.

[0030] <Example 9> This example also starts image recognition, and after rotating an image with angle of rotation detected according to the above-mentioned example (for example, detected angle of rotation makes it rotate 30 degrees clockwise counterclockwise at the time of 30 degrees), the object recognition section 8 performs pattern matching with a dictionary etc., and recognizes an image. For example, an image is recognized by combining with various the matching approaches like pattern matching of seeing the monochrome coincidence degree of the pixel to which an object and the image in a candidate field correspond.

[0031] In addition, although it has the composition of having prepared the processing section of dedication which performs each function, in the above-mentioned example, this invention can change a configuration so that it may not be limited to this, and each function may be included in ROM etc., for example, it may be calculated and processed on a general-purpose processor.

[0032]

[Effect of the Invention] As mentioned above, as explained, according to invention of claims 1, 2, 5, and 6 and seven publications Along with two or more concentric circles from the core of the candidate field of an object, the characteristic quantity data which arranged the mesh data on each periphery in order are created. Since angle of rotation is detected by matching with the characteristic quantity data of the same radius in the dictionary drawn up similarly, angle of rotation of an object is detectable with high

precision from a binary image or a color picture.
[0033] According to invention of claim 3 and four publications, even when the location of the core of a circle shifts by a noise etc., detection precision of angle of rotation of an object is not worsened.
[0034] According to invention of claim 8 and nine publications, even if the specific image used as the candidate for recognition is rotating, it becomes possible from a binary image or a color picture to recognize a specific image with high precision.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The configuration of the example of this invention is shown.
[Drawing 2] The example at the time of dividing the image in a candidate field into a 2x2-pixel mesh (small field) is shown.
[Drawing 3] The example of mesh-data memory about the image of drawing 2 is shown.
[Drawing 4] Characteristic quantity data of the mesh on the periphery of a radius 5 are shown.
[Drawing 5] The example of distance count of the characteristic quantity of the candidate field of a radius 5 and the characteristic quantity of a dictionary is shown.
[Drawing 6] The example of the histogram of angle of rotation detected from each periphery is shown.
[Drawing 7] Other configurations of the example of this invention are shown.
[Drawing 8] The example of calculation of the characteristic quantity data which added the mesh data of 3xperimeter 3 size of an attention mesh is shown.
[Description of Notations]
1 Binary Picture Signal
2 Candidate Field Extract Section
3 Mesh-Data Calculation Section
4 Mesh-Data Memory
5 Characteristic Quantity Calculation Section
6 Angle-of-Rotation Detecting Element
7 Dictionary
8 Object Recognition Section
9 Control Section

[Translation done.]

* NOTICES *

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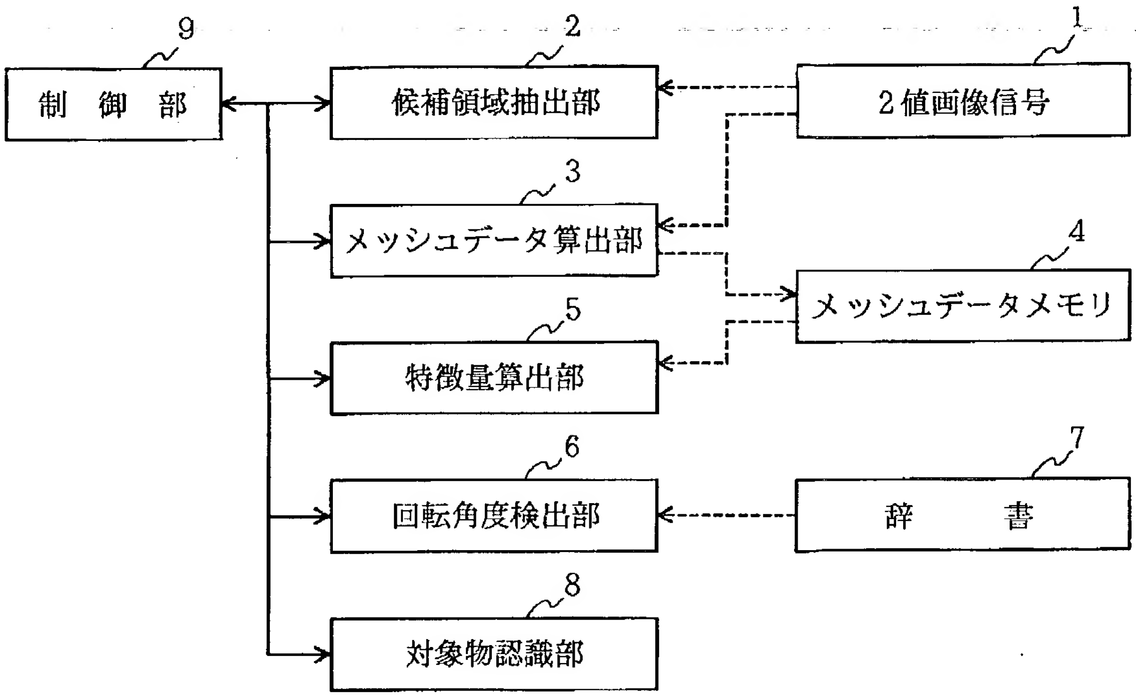
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

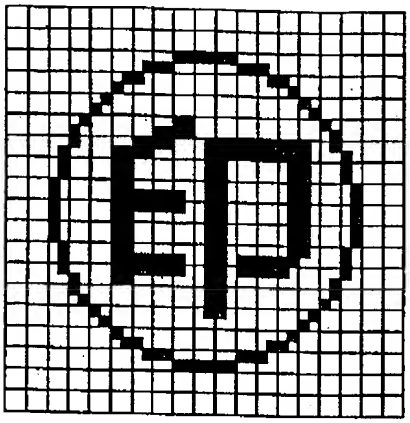
DRAWINGS

[Drawing 1]



[Drawing 2]

画像



■ 画素
□ メッシュ

[Drawing 3]

メッシュデータメモリ

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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	2	2	2	2	2	1	0	0	0	0	0	0
0	0	0	0	0	2	1	0	0	0	0	0	1	2	0	0	0	0	0
0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0
0	0	0	2	0	0	0	2	4	0	0	0	0	0	0	2	0	0	0
0	0	1	1	0	2	4	2	0	2	4	4	4	4	2	1	1	0	0
0	0	2	0	0	4	0	0	0	2	2	0	0	2	2	0	2	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[Drawing 4]

メッシュデータメモリ

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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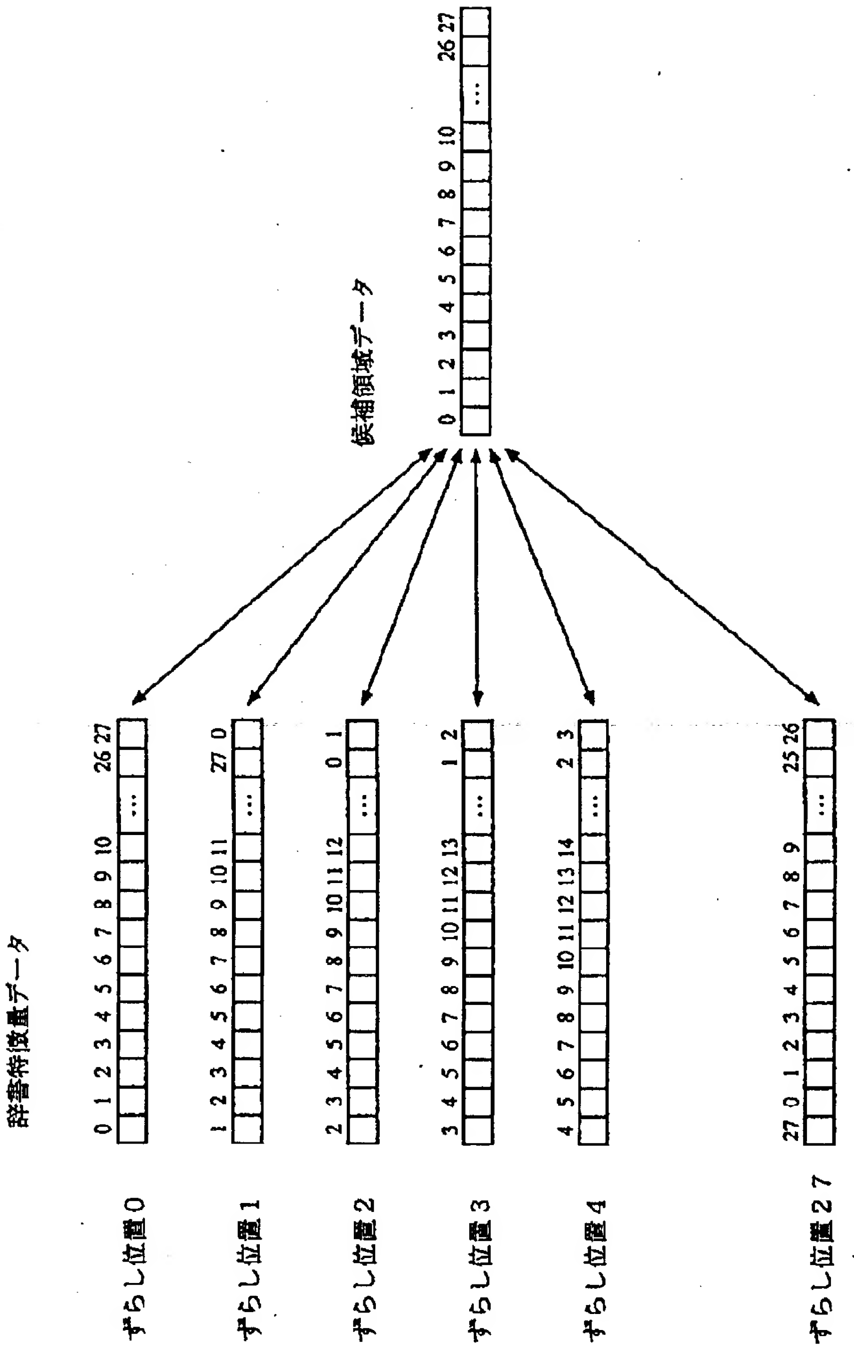
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

メッシュデータ取得順序方向
□ メッシュ
□ 半径5の円周上のメッシュ（注目メッシュ）

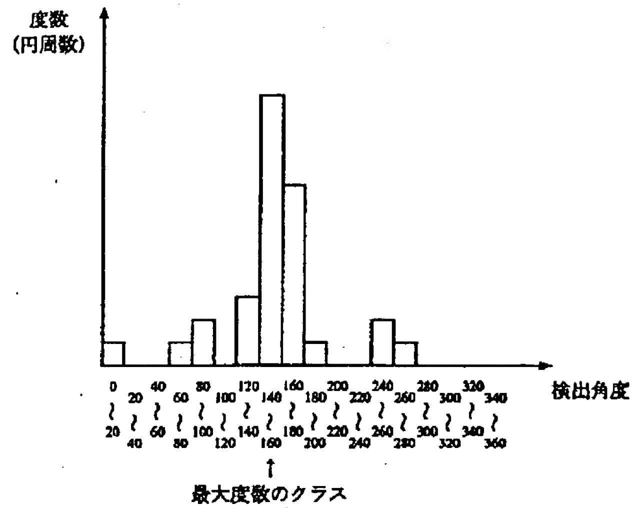
半径5の特徴量データ

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
2	2	2	4	0	0	0	0	0	0	0	2	0	0	0	0	0	4	0	0	0	1	1	0	0	1	1	2

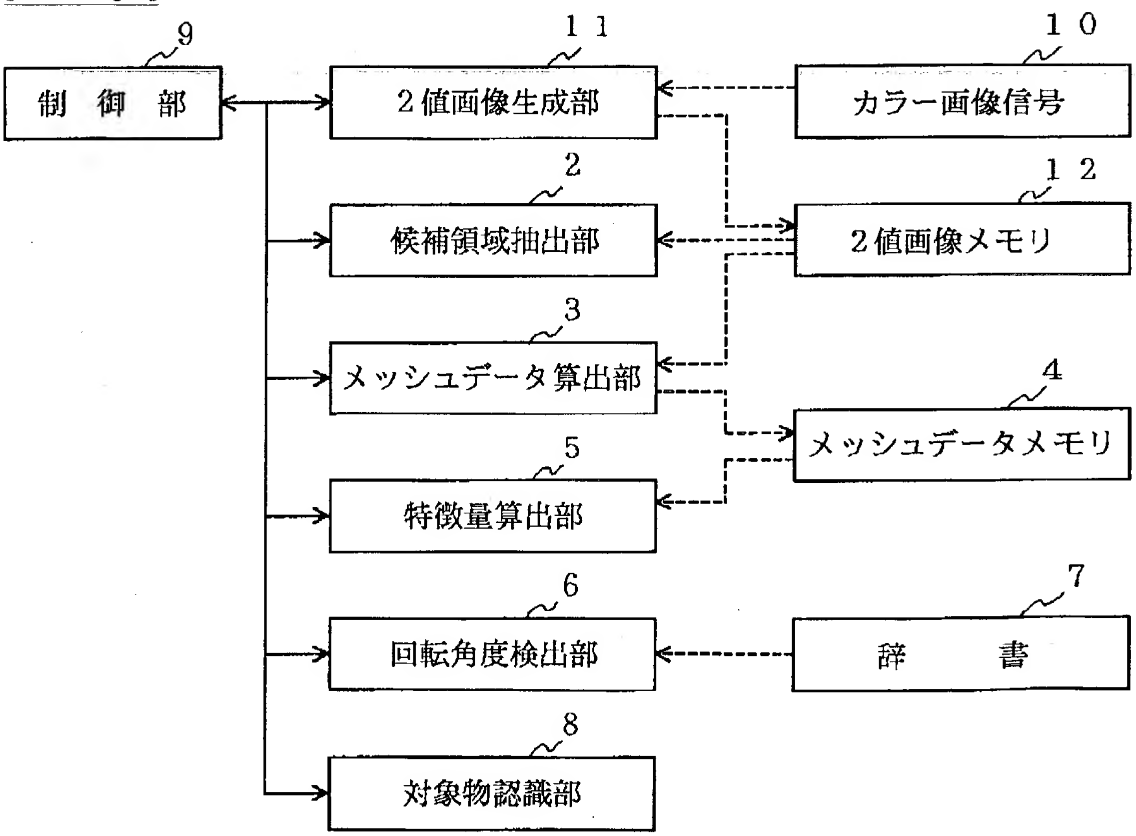
[Drawing 5]


候補領域データ
辞書特徴量データ
ずらし位置0
ずらし位置1
ずらし位置2
ずらし位置3
ずらし位置4
ずらし位置27

[Drawing 6]

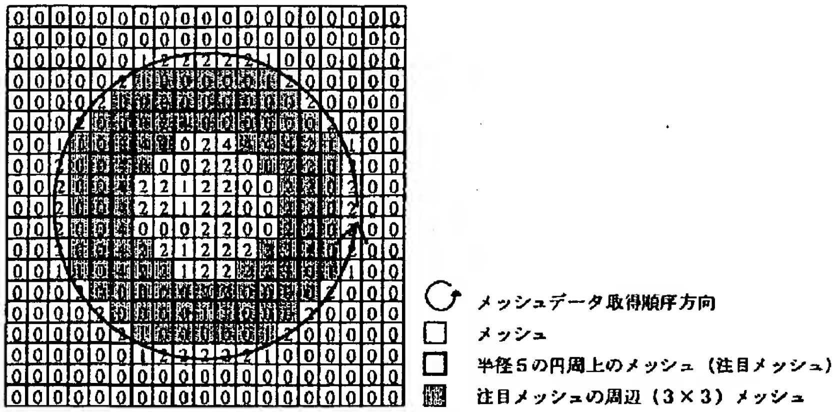


[Drawing 7]



[Drawing 8]

メッシュデータメモリ



半径５の特徴量データ

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
12	12	15	14	12	1	0	4	6	7	10	10	11	12	12	12	13	12	8	1	3	6	6	4	5	9	10	12

[Translation done.]